Challenges for a Distributed Collaborative Environment Functioning over Mobile Wireless Networks

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Plan

- Distributed Collaborative Environment (DCE)
- Middleware Architecture
- OPERA
- Preliminary Bandwidth Characterisation
- Tactical Wireless Environment
- OPERA Middleware in a Wireless Environment
- Conclusions

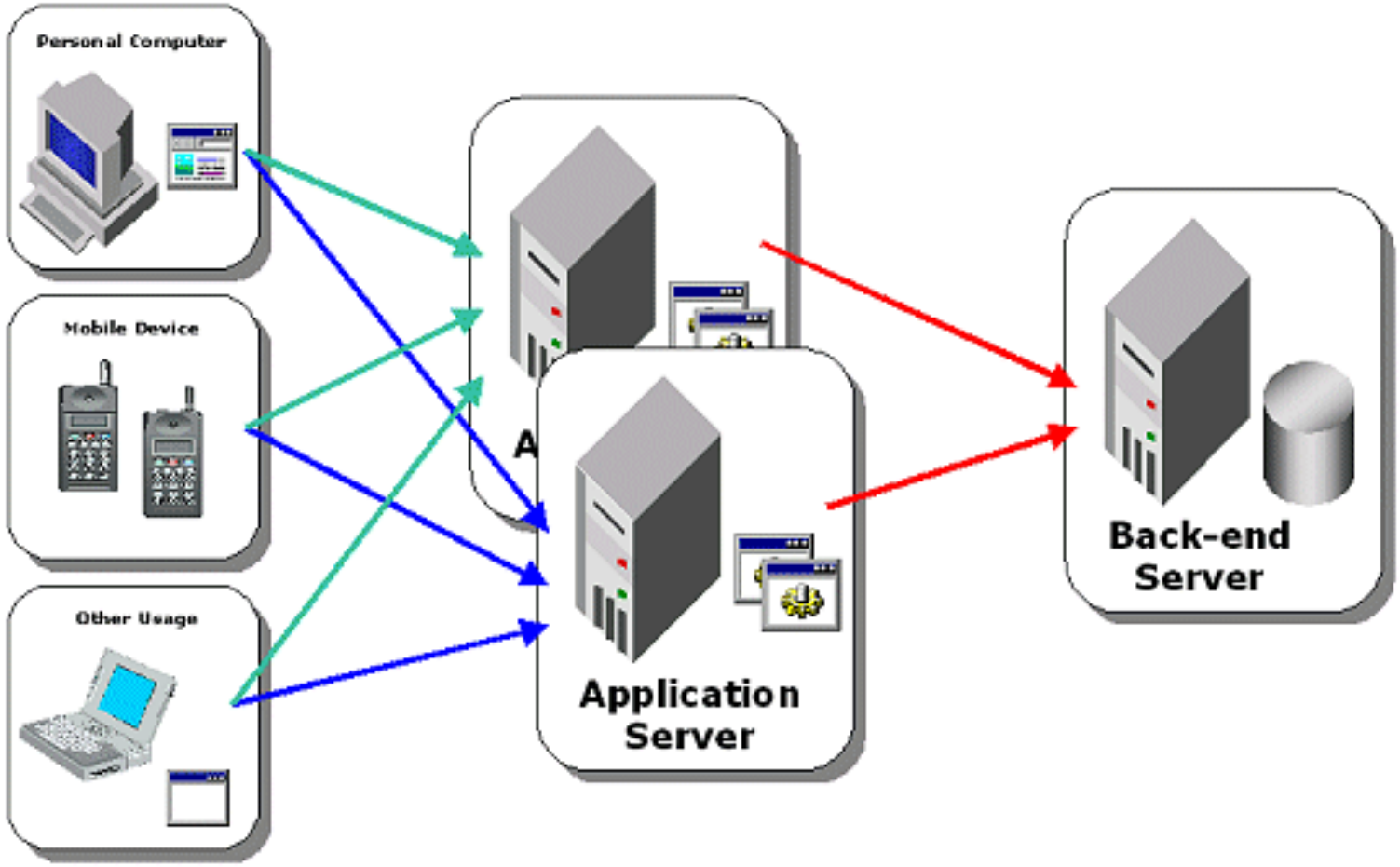
Distributed Collaborative Environment

- Involves direct human participation
- Allows:
  - Sharing of information
  - Discussion of alternatives
  - Making of joint decisions
  - Collective creation of authored work products

Some lessons learned for deployed digital systems

- Need for FBCB2 (Force XX1 Battle Command Brigade and Below) or like device down to company (tactical) level
- More bandwidth; must allow for complete transmission of basic Fragmentary Orders & Graphics to be useful
- Should have near real-time update of assets on battlefield
- Collaborative planning is a must
- Every vehicle and CP needs some type of system
- The collaborative planning tools were almost unusable due to data bottlenecks caused by low bandwidth links

Multi tier Architecture



OPERA

OPERA

- Stands for “Operational Planning Environment and Reference Application
- Provides easy access to information on doctrines, organizations, equipment and resources
- Is a set of planning and calculation tools
- Facilitates the collaborative planning carried out by a group of functional staff experts
- Provides workflow control

OPERA Functionality

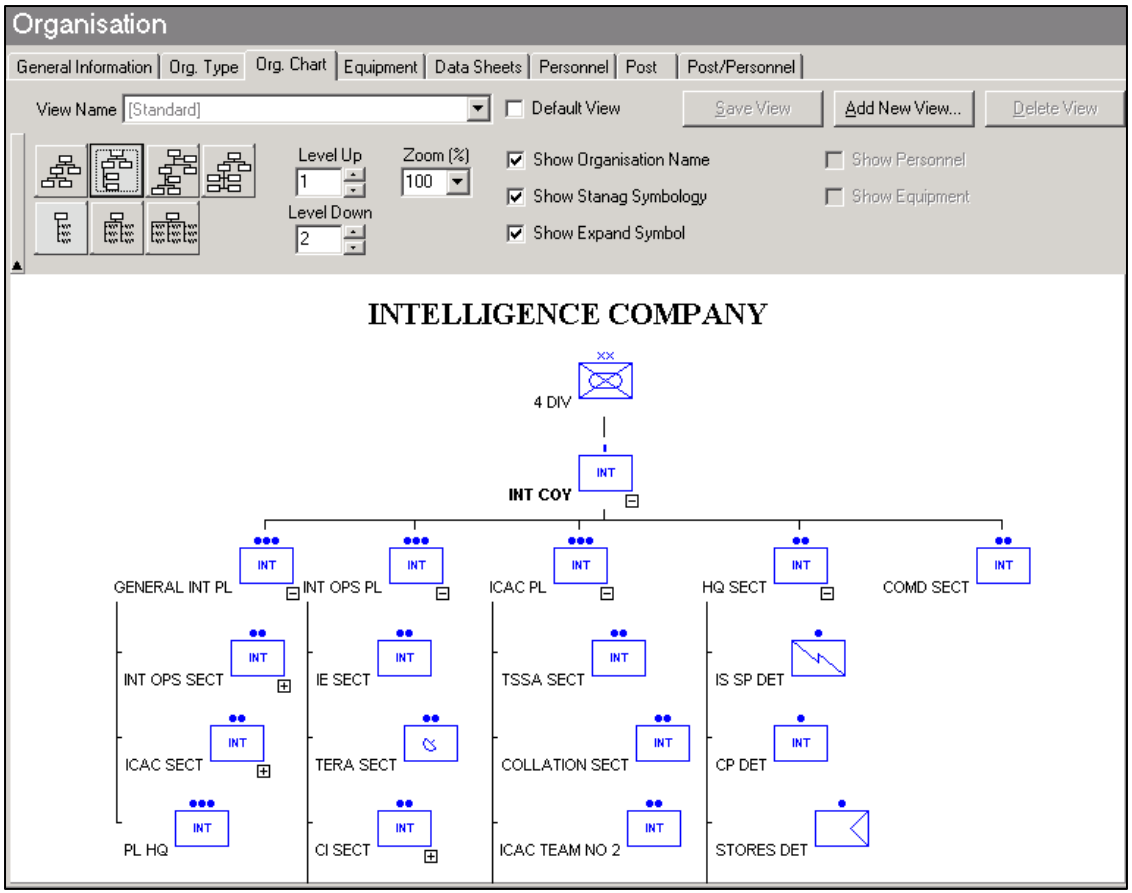
- Browsers
  - Equipment
  - ORBAT (Organization and personnel)
- Staff Checks, Planners and Calculators
  - Task
  - Logistic
  - Lift
  - Movement (Road, Air and Rail)

OPERA - Multi-User environment

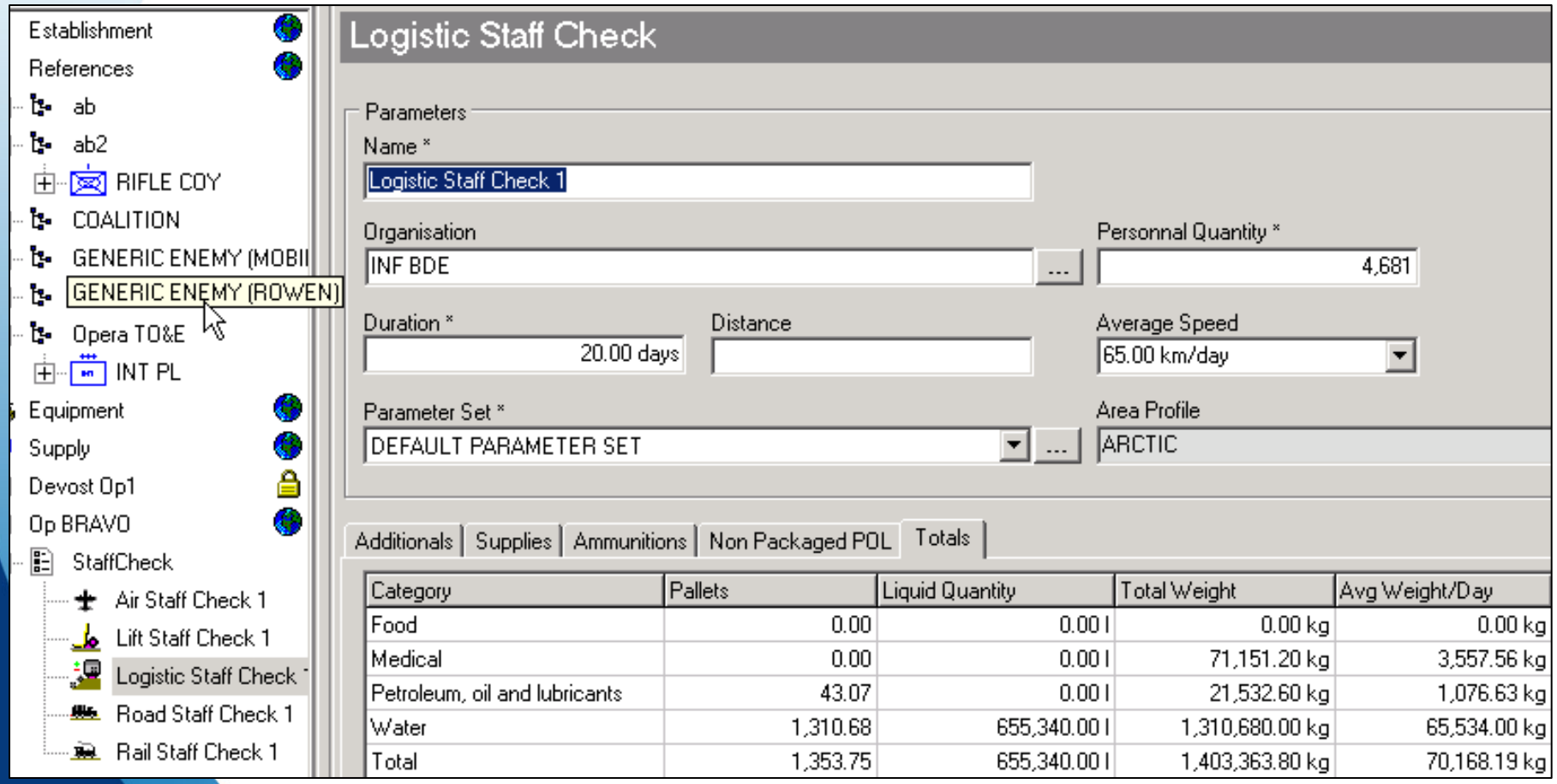
OPERA – Current users

- Corps
  - Division
    - Brigade
      - Regiment
        - » Company

OPERA – ORBAT Browser

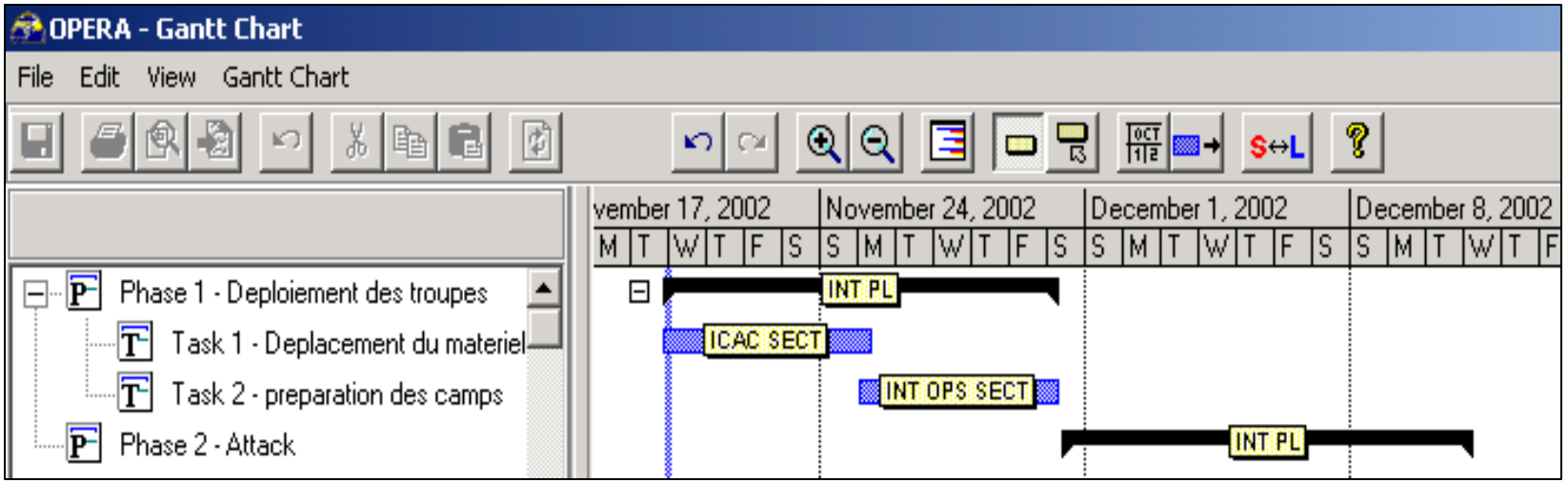


OPERA Logistic Staff Check

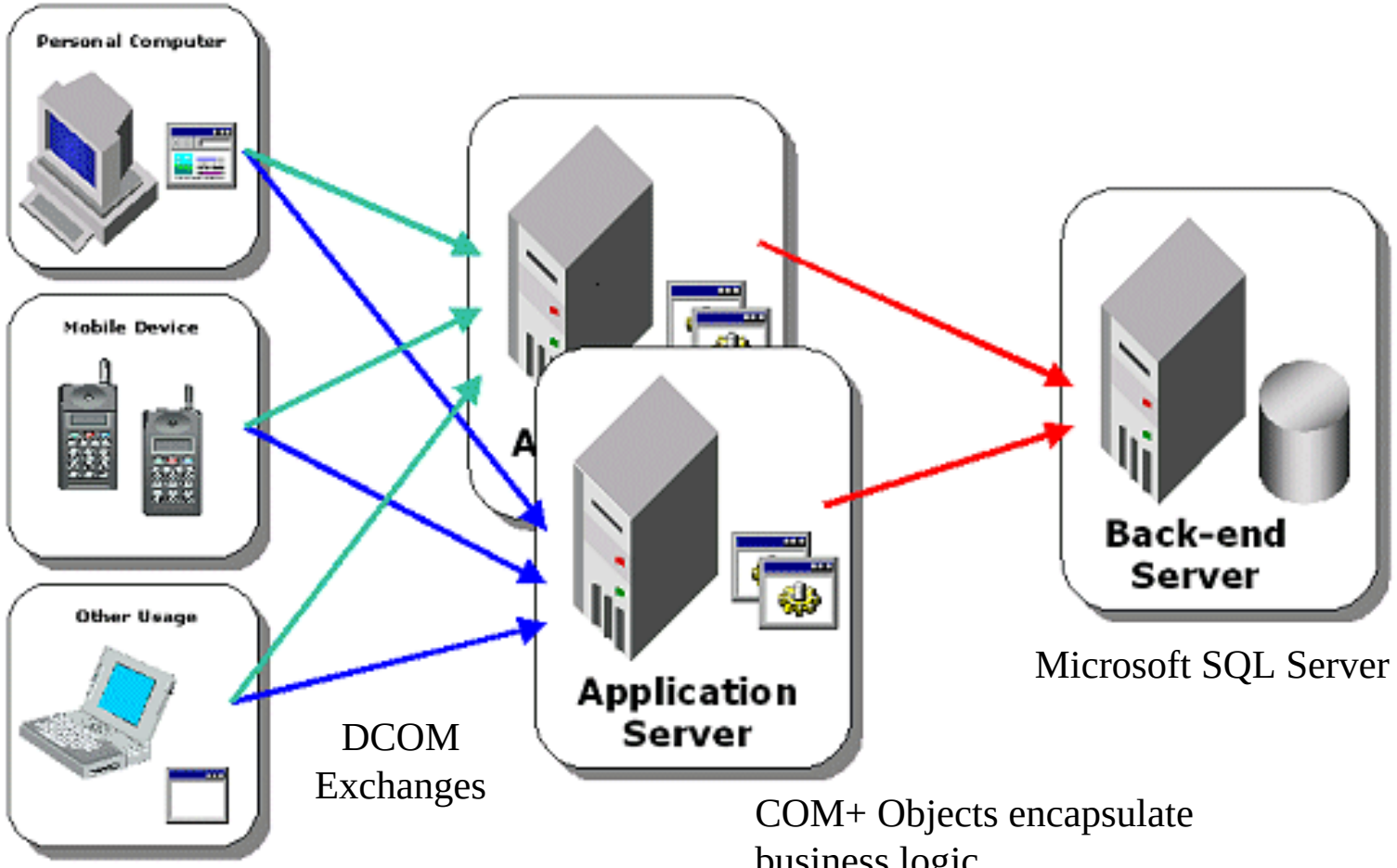


Category	Pallets	Liquid Quantity	Total Weight	Avg Weight/Day
Food	0.00	0.00 l	0.00 kg	0.00 kg
Medical	0.00	0.00 l	71,151.20 kg	3,557.56 kg
Petroleum, oil and lubricants	43.07	0.00 l	21,532.60 kg	1,076.63 kg
Water	1,310.68	655,340.00 l	1,310,680.00 kg	65,534.00 kg
Total	1,353.75	655,340.00 l	1,403,363.80 kg	70,168.19 kg

OPERA Task Planning



OPERA Architecture



Thin Client

DCOM Exchanges

COM+ Objects encapsulate business logic

Microsoft SQL Server

OPERA - Bandwidth Characterization

- The objective was to determine the bandwidth required by OPERA for performing distributed collaborative planning
- The measurements of the network traffic occurred between the client and the application server
- Measurements included all network level exchanges.
- The testing was performed using an organization of a size of a Brigade
- 60 functions were evaluated

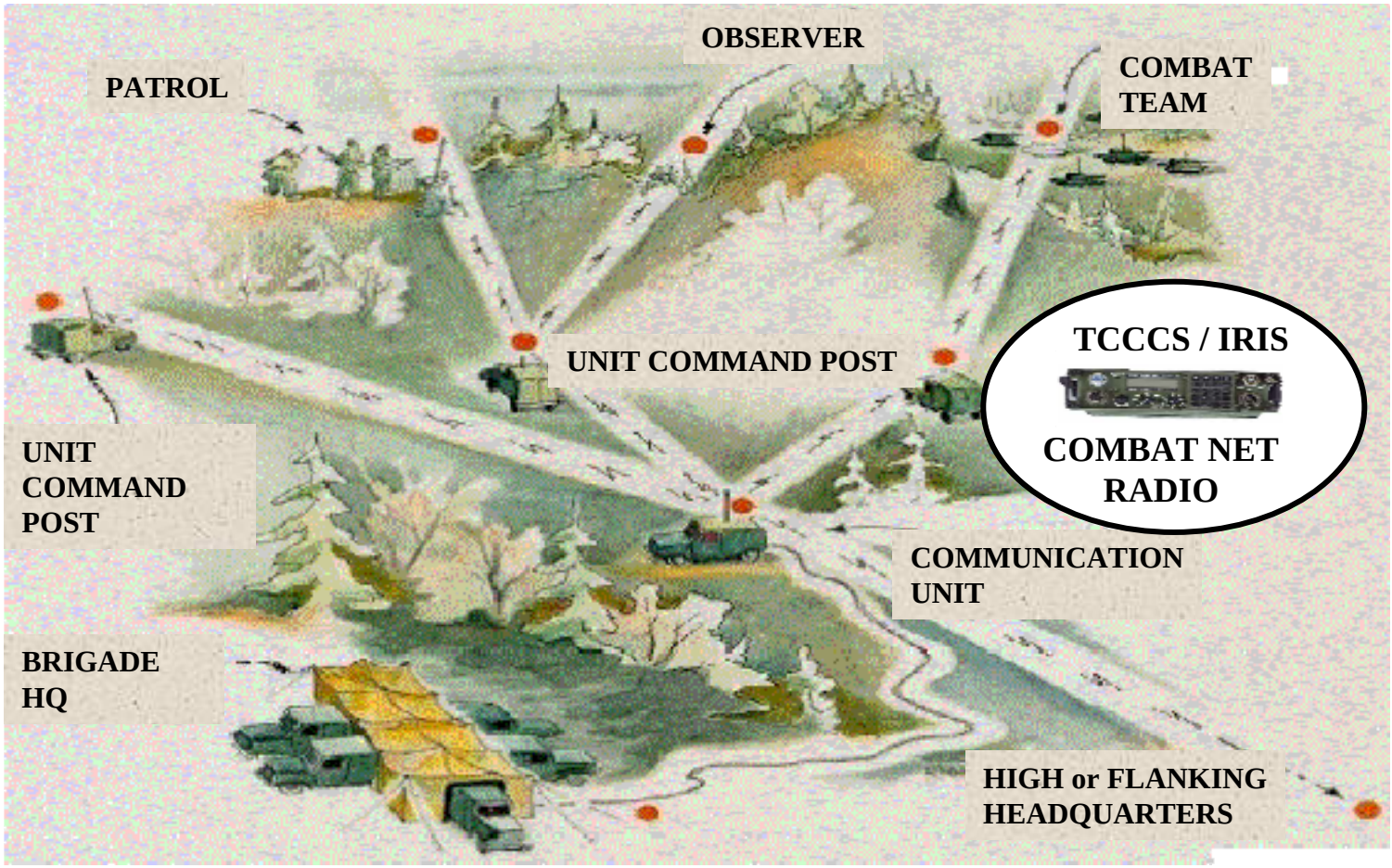
OPERA - Bandwidth Characterization (cont.)

- The test was performed a total of three times. The first test was to validate the scenario. The second and the third tests were to compile the measurement data into a comparison grid and to validate the results.
- The execution of the tests was done in an almost perfect network environment.
  - one client and one server with no other network or other application traffic generated by other users

Bandwidth Characterization (Results)

- Basic traffic of 250 bytes per minute just to keep connections alive
- 33 functions (out of 60) exchange more than 100k bytes
- The display of a calculation progress bar consumed many network resources
  - a request sent from the client to the application server each 25 millisecs

The Tactical Domain



Effects associated with mobile wireless communication grids

- low bandwidth (often less than 1000 bits/sec)
- variable throughput, and
- unreliable connectivity (frequent disconnections)

Potential Issues with OPERA in the tactical domain

- Keeping calculation progress bar updated in multi tier architecture consumed considerable bandwidth
- Potential disconnection due to network latency
- Forced disconnections cause clients and servers to be shutdown and restarted.
- The response time for most of the OPERA functions would be higher than 80 secs at 1k bits/sec

Probable Characteristics of Planning Process in Tactical Domain

- Developed and executed more rapidly
  - shorter time horizons
- Oriented toward tasks and movements
  - shorter, fewer logistical calculations
- More interactive
  - less workflow-oriented
  - more use of map overlays

Conclusions

- Distributed collaborative environment (DCE) offers tools to make joint decisions but requires human in loop
- OPERA is an instance of DCE based on a multi-tier architecture using distributed object middleware
- The battlefield provides very limited bandwidth for communications in the tactical domain
- Deployment of DCE like OPERA in a wireless environment raises major issues
  - response time
  - effects of disconnections
  - need to reduce volume of data transmitted
  - need for multi-tier architecture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